In re Patent Application of: Tomojiro Sugimoto, Keiso Takeda, Shigeo Furuno, Kimitaka Saito, Yasuhide Tani, Atsuya Okamoto, Takehiko Kato, Tatsushi Nakashima
Serial No. 10/826,355 Examiner: Seth Barney
Filed: April 19, 2004 Group Art Unit: 3752
For:

FUEL INJECTION VALVE

TRANSLATOR'S DECLARATION

Honorable Commissioner of Patents & Trademarks
Washington, D.C. 20231

Sir:

I, Takayuki Tanaka , residing at c/o A. AOKI, ISHIDA & ASSOCIATES, Toranomon 37 Mori Bldg., 3-5-1, Toranomon Minato-ku, Tokyo 105-8423, Japan declare the following:

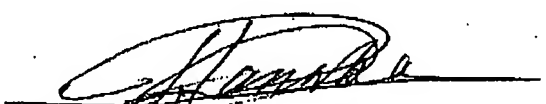
(1) That I know well both the Japanese and English languages;

(2) That I translated Japanese Patent Application No. 2003-122104 , filed April 25, 2003 , from the Japanese language to the English language;

(3) That the attached English translation is a true and correct translation of the aforesaid Japanese Patent Application No. 2003-122104 to the best of my knowledge and belief; and

(4) That all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements are made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and that such false statements may jeopardize the validity of the application or any patent issuing thereon.

on January 17, 2005
Date



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Mr. Shinichiro Ota

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[TITLE OF THE INVENTION] FUEL INJECTION VALVE

[NUMBER OF CLAIMS] 9

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[Name of Article]	Specification	1
[Name of Article]	Drawing	1
[Name of Article]	Abstract	1
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[General Authorization Number]	9905714	
[General Authorization Number]	9503250	
[General Authorization Number]	9905715	

[NEED FOR PROOF] Yes

[NAME OF DOCUMENT]

Specification

[TITLE OF THE INVENTION]

FUEL INJECTION VALVE

[SCOPE OF CLAIM FOR PATENT]

[CLAIM 1]

A fuel injection valve in which a nozzle hole is formed on a metering plate and fuel flowing on a face on the upstream side of the metering plate is injected outside of a face on the downstream side of the metering plate, the fuel injection valve comprising:

a vortex flow generator means for making a flow of fuel passing in the nozzle hole form into a vortex flow, wherein the vortex flow generator means is provided on the upstream side of the metering plate.

[CLAIM 2]

A fuel injection valve according to claim 1, wherein the vortex flow generator means is a vortex flow generator groove provided on a face on the upstream side of the metering plate so that the vortex flow generator groove can be connected to a wall face of the inlet of the nozzle hole, and a main stream of fuel flowing in the groove is directed to a position deviating from a center of the nozzle hole.

[CLAIM 3]

A fuel injection valve according to claim 2, wherein the following relations are established,

$L \times 1/5 < F < L \times 2/3$

$D \times 1/2 < N < D \times 3$

$D \times 1/5 < H < D \times 2/3$

$D \times 1/5 < B < D \times 1/2$,

where F is depth of the vortex flow generator groove, N is length, H is width, and B is an offset of the center line in the longitudinal direction from the center of the nozzle hole.

[CLAIM 4]

A fuel injection valve according to claim 2, wherein

the vortex flow generator groove is formed so that a flow of fuel from the outer circumferential side of the metering plate can be guided by the groove.

[CLAIM 5]

A fuel injection valve according to claim 2, wherein a plurality of vortex flow generators are provided for one nozzle hole.

[CLAIM 6]

A fuel injection valve according to claim 2, wherein depth of the vortex flow generator groove is formed to be constant, increased or decreased toward the nozzle hole.

[CLAIM 7]

A fuel injection valve according to claim 2, wherein the shape of the vortex flow generator groove is a rectangle, a semi-ellipse, a triangle having one vertex on the nozzle hole side, a triangle having one vertex on the end portion side or a comma-shape curved in the direction of revolution of fuel.

[CLAIM 8]

A fuel injection valve according to claim 1, wherein the vortex flow generator means is a guide protrusion formed on an upper face of the metering plate.

[CLAIM 9]

A fuel injection valve in which a nozzle hole is formed on a metering plate, fuel flowing on a face on the upstream side of the metering plate is injected outside of a face on the downstream side of the metering plate and a needle having a forward end face opposed to the metering plate is arranged on the upstream side of the metering plate, the fuel injection valve comprising:

a vortex flow generator means for making a flow of fuel passing in the nozzle hole form into a vortex flow, wherein the vortex flow generator means is guide protrusion formed on the forward end face of the needle.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[TECHNICAL FIELD OF THE INVENTION]

The present invention relates to a fuel injection valve.

[0002]

[PRIOR ART]

In order to inject fuel into a cylinder of an internal combustion engine, a fuel injection valve is used. The following type of fuel injection valve is provided. As shown in Fig. 12, the metering plate 3 is arranged in the front of the forward end portion of the needle 2 which is slidably provided in the valve body 1. Via the fuel passage 4 formed between the valve body 1 and the needle 2, fuel flowing between the lower face of the needle 2 and the upper face of the metering plate 3 is injected from the nozzle hole 5 formed on the metering plate 3. Fig. 13 is a top view of the metering plate 3, on which a plurality of nozzle holes 5 are equally formed. Fig. 14A is a top view showing a flow of fuel around one nozzle hole 5. Fig. 14B is a sectional side view of the flow of fuel around the nozzle hole 5. In this case, fuel is cylindrically injected, and what is called a liquid column spray is generated.

As disclosed in the official gazette of Japanese Unexamined Patent Publication No. 9-32695, there is provided a fuel injection valve in which the nozzle hole 5 is obliquely formed so as to suppress the generation of a liquid column spray.

[0003]

[patent paper 1]

Japanese Unexamined Patent Publication No. 9-32695

[PROBLEMS TO BE SOLVED BY THE INVENTION]

[0004]

However, the regulations regarding exhaust gases have been further strengthened recently. Accordingly, there is a possibility that the above fuel injection valve of the prior art will be insufficient to fulfil these regulations, and a demand for a fuel injection valve capable of better atomizing

of fuel.

In view of the above problems, it is an object of the present invention to provide a fuel injection valve capable of better atomizing of fuel.

[0005]

According to the invention described in claim 1, there is provided a fuel injection valve in which a nozzle hole is formed on a metering plate and fuel flowing on a face on the upstream side of the metering plate is injected outside of a face on the downstream side of the metering plate, the fuel injection valve comprises a vortex flow generator means for making a flow of fuel passing in the nozzle hole formed into a vortex flow, wherein the vortex flow generator means is provided on the upstream side of the metering plate.

According to the fuel injection valve constructed as described above, fuel is ejected from nozzle holes after being formed into vortex flow in the nozzle holes so that the fuel is diffused in a megaphone shape, and is well atomized, without forming a liquid column spray.

[0006]

According to the invention described in claim 2, there is provided a fuel injection valve according to claim 1, wherein the vortex flow generator means is a vortex flow generator groove provided on a face on the upstream side of the metering plate so that the vortex flow generator groove can be connected to a wall face of the inlet of the nozzle hole, and a main stream of fuel flowing in the groove is directed to a position deviating from a center of the nozzle hole.

According to the fuel injection valve constructed as described above, fuel is formed into a vortex flow in the nozzle holes by the vortex flow generator groove.

[0007]

According to the invention described in claim 3, there is provided a fuel injection valve according to claim 2, wherein the following relations are established,

$L \times 1/5 < F < L \times 2/3$

$D \times 1/2 < N < D \times 3$

$D \times 1/5 < H < D \times 2/3$

$D \times 1/5 < B < D \times 1/2$,

where F is depth of the vortex flow generator groove, N is length, H is width, and B is an offset of the center line in the longitudinal direction from the center of the nozzle hole.

[0008]

According to the invention described in claim 4, there is provided a fuel injection valve according to claim 2, wherein the vortex flow generator groove is formed so that a flow of fuel from the outer circumferential side of the metering plate can be guided by the groove.

[0009]

According to the invention described in claim 5, there is provided a fuel injection valve according to claim 2, wherein a plurality of vortex flow generators are provided for one nozzle hole.

According to the fuel injection valve constructed as described above, a strong vortex flow is given to the fuel by a plurality of vortex flow generator grooves.

[0010]

According to the invention described in claim 6, there is provided a fuel injection valve according to claim 2, wherein depth of the vortex flow generator groove is formed to be constant, increased or decreased toward the nozzle hole.

[0011]

According to the invention described in claim 7, there is provided a fuel injection valve according to claim 2, wherein the shape of the vortex flow generator groove is a rectangle, a semi-ellipse, a triangle having one vertex on the nozzle hole side, a triangle having one vertex on the end portion side or a comma-shape curved in the direction of revolution of fuel.

[0012]

According to the invention described in claim 8, there is

provided a fuel injection valve according to claim 2, wherein the vortex flow generator means is a guide protrusion formed on an upper face of the metering plate.

According to the fuel injection valve constructed as described above, fuel is ejected from nozzle holes after being formed into a vortex flow in the nozzle holes by the guide protrusion formed on an upper face of the metering plate so that the fuel is diffused in a megaphone shape, and is well atomized without forming a liquid column spray.

[0013]

According to the invention described in claim 9, there is provided a fuel injection valve in which a nozzle hole is formed on a metering plate, fuel flowing on a face on the upstream side of the metering plate is injected outside of a face on the downstream side of the metering plate and a needle having a forward end face opposed to the metering plate is arranged on the upstream side of the metering plate, comprising a vortex flow generator means for making a flow of fuel passing in the nozzle hole form into a vortex flow, wherein the vortex flow generator means is guide protrusion formed on the forward end face of the needle.

According to the fuel injection valve constructed as described above, fuel is ejected from nozzle holes after being formed into vortex flow in the nozzle holes by the guide protrusion formed on a forward end face of the needle so that the fuel is diffused in a megaphone shape, and is well atomized, without forming a liquid column spray.

[0014]

[EMBODIMENT]

Referring to the accompanying drawings, each embodiment of the present invention will be explained below.

First of all, the first embodiment is explained as follows. Fig. 1 is a top view of the metering plate 3 provided in the first embodiment, that is, Fig. 1 is a view of the metering plate 3, wherein the view is taken from the upstream

side of a flow of fuel. A plurality of nozzle holes 5 (in this case, five nozzle holes) are provided on the metering plate 3. On an upper face of the metering plate 3, the vortex flow generator grooves 10 are provided.

[0015]

As shown in the drawing, each vortex flow generator groove 10 is formed as follows. Center line X of the vortex flow generator groove 10 in the longitudinal direction is substantially directed from the circumferential side of the metering plate 3 to the center. However, center line X of the vortex flow generator groove 10 in the longitudinal direction is shifted from center P of the nozzle hole 5 so that center line X cannot pass through center P of the nozzle hole 5. One wall face of the vortex flow generator groove 10 in the longitudinal direction is tangentially connected to the wall face of the nozzle hole 5. In this connection, the outer circumferential circle of the metering plate 3 represents an effective region of the metering plate 3, that is, the outer circumferential circle of the metering plate 3 represents a region in which fuel flows on the upstream side surface.

[0015]

(A) of Fig. 2 is a top view showing a flow of fuel from the vortex flow generator groove 10 into one nozzle hole 5. The flow of fuel passing in the vortex flow generator groove 10 revolves along the wall of the nozzle hole 5, and a vortex flow is generated. (B) of Fig. 2 is a sectional view taken on line IIB - IIB in (A) of Fig. 2. The flow of fuel proceeds inside the nozzle hole being spirally revolved. Then the flow of fuel is diffused like a megaphone-shape and injected from the outlet 11 of the nozzle hole 5 and excellently atomized. Therefore, a liquid column spray, which is usually formed in the fuel injection valve of the prior art, is not formed.

[0016]

Next, explanations are made into the dimensions of each portion of the vortex flow generator 10 so as to generate an

excellent vortex flow. First, referring to (A) of Fig. 3, the dimensions are defined as follows.

Thickness of the metering plate 3: L

Diameter of the nozzle hole 5: D

Depth of the vortex flow generator groove 10: F

Further, referring to Fig. 3B, the dimensions are defined as follows.

Passage width of the vortex flow generator groove 10: H

Passage length of the vortex flow generator groove 10: N (To be specific, the passage length of the vortex flow generator groove 10 is a distance from the point of intersection, at which a line passing through the center of the vortex flow generator groove 10 in the width direction crosses a line passing through the center of the nozzle hole 5 perpendicular to this line, to the end portion of the vortex flow generator groove 10.)

Offset distance from the center of the nozzle hole 5 to the center of the vortex flow generator groove 10 in the width direction: B

[0018]

In order to obtain a predetermined vortex strength according to the above definition, depth F of the vortex flow generator groove 10 must satisfy the following inequality with respect to thickness L of the metering plate 3 as shown in (A) of Fig. 4.

$L \times 1/5 < F < L \times 2/3$

As shown in (B) of Fig. 4, passage length N of the vortex flow generator groove 10 satisfies the following inequality with respect to diameter D of the nozzle hole 5.

$D \times 1/2 < N < D \times 3$

As shown in (C) of Fig. 4, passage width H of the vortex flow generator groove 10 satisfies the following inequality with respect to diameter D of the nozzle hole 5.

$D \times 1/5 < D < L \times 2/3$

As shown in (D) of Fig. 4, passage offset B of the vortex

flow generator groove 10 satisfies the following inequality with respect to diameter D of the nozzle hole 5.

$D \times 1/5 < D < L \times 1/2$

[0019]

Next, referring to Fig. 5 , explanations will be made into variations of the vortex flow generator groove 10.

In (A) of Fig. 5, the standard vortex flow generator groove 10 is shown, that is, as shown in (A) of Fig. 3, the depth of the vortex flow generator groove 10 is constant from the end portion to the nozzle 5. In (B) of Fig. 5, the depth of the vortex flow generator groove 10 increases when it comes from the end portion to the nozzle hole 5. In (C) of Fig. 5, the depth of the vortex flow generator groove 10 decreases when it comes from the end portion to the nozzle hole 5. In the structure shown in (B) of Fig. 5, the fuel injection force is high, however, the vortex strength is low. In the structure shown in Fig. 5C, the fuel injection force is low, however, the vortex strength is high. In the structure shown in (A) of Fig. 5, the fuel injection force and vortex strength are, respectively, medium.

[0020]

Next, referring to (A) of Fig. 6 to (E) of Fig. 6, explanations will be made into variations in which the shape of the vortex flow generator groove 10 (the shape of a top face of the vortex flow generator groove 10) is changed.

(A) of Fig. 6 shows the standard structure, that is, as (A) of Fig. 3 shows, the top view shape of the vortex flow generator groove 10 is a rectangle. (B) of Fig. 6 shows a case in which the top view shape of the vortex flow generator groove 10 is a semi-ellipse which is curved from the end portion side to the nozzle hole side. (C) of Fig. 6 shows a case in which the top view shape of the vortex flow generator groove 10 is a triangle having one vertical angle at the end portion side which is linearly extended from the end portion side to the nozzle hole side. (D) of Fig. 6 shows a case in which the top

view shape of the vortex flow generator groove 10 is a comma-shape, at the middle portion of which the comma-shape is curved in the same direction as the direction of revolution. (E) of Fig. 6 shows a case in which the top view shape of the vortex flow generator groove 10 is a triangle, the nozzle hole 5 side of which is reduced. In this connection, in all the vortex flow generator grooves 10 shown in Fig. 6, the peripheral portion of the metering plate 3 is located on the right in the drawing, and fuel flows in the direction shown by the arrow.

[0021]

Next, referring to Fig. 7, explanations will be made into variations in which the number of the passages of the vortex flow generator groove 10 is changed.

(A) of Fig. 7 shows the standard passage of the vortex flow generator groove 10, that is, as shown in (A) of Fig. 3, one vortex flow generator groove 10 is provided. (B) of Fig. 7 shows a case in which two vortex flow generator grooves 10 are point-symmetrically arranged with respect to the center of the nozzle hole 5. (C) of Fig. 7 shows a case in which three vortex flow generator grooves 10 are point-symmetrically arranged with respect to the center of the nozzle hole 5. (D) of Fig. 7 shows a case in which four vortex flow generator grooves 10 are point-symmetrically arranged with respect to the center of the nozzle hole 5. The greater the number of the passages, the higher the vortex strength.

[0022]

Next, referring to Fig. 8, explanations will be made into variations of the shape of the nozzle hole 5.

(A) of Fig. 8 shows the standard shape, that is, a top view of the straight nozzle hole 5 which extends straight perpendicularly to the face of the metering plate 3 as shown in (A) of Fig. 3. (D) of Fig. 8 is a sectional view thereof.

(B) of Fig. 8 shows an oblique nozzle hole 5 which obliquely extends with respect to the surface of the metering plate 3. (E) of Fig. 9 is the sectional view thereof.

(C) of Fig. 8 shows a deformed nozzle hole 5, the nozzle hole of which is an octagonal star shape. (E) of Fig. 8 is the sectional view thereof.

In this connection, the shape of the nozzle hole 5 is not limited to the above specific embodiments, that is, various shapes can be adopted.

[0023]

In the first embodiment described above including the variations, fuel is made to be a vortex flow in the nozzle hole 5 by the vortex flow generator groove 10 and injected from an outlet of the nozzle hole 5. The thus injected fuel is diffused into a megaphone-shape and excellently atomized without being formed into a liquid column spray.

[0024]

Next, the second embodiment will be explained below. In this second embodiment, the guide protrusions 11, which are formed into a rib-shape and rising upward, are provided on an upper face of the metering plate 3, and fuel is guided into the nozzle holes 5 being rotated by these guide protrusions 11. Fig. 9 is a top view of the metering plate 3 of the second embodiment. In this connection, in the structure shown in Fig. 9, the nozzle holes 5 are arranged round the center of the metering plate 3 being distributed by an unequal angle. Therefore, the guide protrusions 11 of the three nozzle holes 5, which are located on the upper side and the left in the drawing, are arranged clockwise in the drawing. The guide protrusions 11 of the two nozzle holes 5, which are located on the lower side in the drawing, are arranged counterclockwise in the drawing. If the nozzle holes 5 are equally arranged on the metering plate 5, the guide protrusions 11 of the nozzle holes 5 are not necessarily arranged like this. Concerning the shape of the nozzle holes 5, the straight nozzle holes 5 are shown in the drawing, however, the variation nozzle holes 5 as shown in Fig. 8, may be adopted. In this connection, a protruding distance of each guide protrusion 11 is determined so that the

needle 2 can not collide with the guide protrusion 11 when the needle 2 is extremely protruded, however, a grove corresponding to the guide protrusion 11 may be formed on the lower face.

In the second embodiment, fuel flowing from the peripheral side of the metering plate 10 composed as described above is revolved by the guides 11 and introduced into the nozzle holes 5. Therefore, the same effect as that of the first embodiment can be provided.

[0025]

Next, the third embodiment will be explained below. In this third embodiment, the guide protrusions 12, which are formed into a rib-shape and rising from the lower face, are provided at the forward end portion of the needle 2, and fuel is revolved and introduced into the nozzle holes 5 by these guide protrusions 12. Fig. 10 is a view of the forward end face of the needle 2 of the third embodiment, wherein the view is taken from the metering plate 3 side. In Fig. 10, the broken lines show the effective region of the metering plate 3, on the upper face of which fuel flows, and the positions of the nozzle holes 5. In this connection, in the same manner as that of Fig. 9, in Fig. 10, the nozzle holes 5 are arranged round the center being distributed by an unequal angle. In this connection, in the third embodiment, if the needle 2 is rotated round the axis, it becomes impossible to guide a vortex flow into each nozzle hole 5. Therefore, the needle 2 is fixed by an appropriate method so that it can not be rotated.

In the third embodiment, fuel flowing from the peripheral side of the metering plate 10 composed as described above is revolved by the guide protrusions 12 and introduced into the nozzle holes 5, and the same effect as that of the first embodiment can be provided.

[0026]

[EFFECT OF THE INVENTION]

A fuel injection valve of the present invention enjects fuel from a nozzle hole formed on a metering plate, wherein the

valve comprises a vortex flow generator means for forming a flow of fuel passing in the nozzle hole form into a vortex flow, so that the fuel is formed into vortex flow in the nozzle hole and is diffused from an outlet of the nozzle hole in a megaphone shape, and well atomized, without forming a liquid column spray.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

A top view of the plate of the first embodiment of the present invention.

[Fig. 2]

Views to explain the flow of fuel around the neighborhood of a nozzle hole, wherein

(A) is a top view of the flow of fuel taken from a position over the nozzle hole.

(B) is a sectional view taken on line IIB - IIB in (A) of Fig. 2.

[Fig. 3]

Views showing a dimensional position of each portion to determine the item value of the nozzle hole, wherein (A) is the view is taken from a position over the nozzle hole.

(B) is a sectional view.

[Fig. 4]

Graphs showing appropriate values for various portions of a vortex flow generator groove.

(A) shows an appropriate value of the depth of a vortex flow generator groove.

(B) shows an appropriate value of the length of a vortex flow generator groove.

(C) shows an appropriate value of the width of the vortex flow generator groove.

(D) shows an appropriate value of the the offset of the vortex flow generator groove.

[Fig. 5]

Views showing variations of depth of a vortex flow

generator groove, wherein
(A) shows a case in which the depth is constant.
(B) shows a case in which the depth is gradually increased when it comes close to a nozzle hole.
(C) shows a case in which the depth is gradually decreased when it comes close to a nozzle hole.

[Fig. 6]

Views showing variations of shape of an upper surface of a vortex flow generator groove, wherein
(A) shows an upper surface which is formed into a rectangle.
(B) shows an upper surface which is formed into a semi-ellipse gradually extending onto the nozzle hole side.
(C) shows an upper surface which is formed into into a triangle linearly extending onto the nozzle hole side.
(D) shows an upper surface which is formed into a comma-shape curved according to a vortex flow.
(E) shows an upper surface which is formed into a triangle linearly reduced on the nozzle hole side.

[Fig. 7]

Views showing variations of numbers of vortex flow generator provided with one nozzle hole, wherein
(A) shows a nozzle hole provided with one vortex flow generator groove.
(B) shows a nozzle hole provided with two vortex flow generator grooves.
(C) shows a nozzle hole provided with three vortex flow generator grooves.
(D) shows a nozzle hole provided with four vortex flow generator grooves.

[Fig. 8]

Views showing variations of shape of the nozzle holes, wherein
(A) is a top view of a straight nozzle hole.
(B) is a top view of an oblique nozzle hole.
(C) is a top view of a nozzle hole with deformed cross

section.

(D) is a sectional view of a straight nozzle hole of (A).

(E) is a sectional view of an oblique nozzle hole of (B).

(F) is a sectional view of a nozzle hole of (C) with deformed cross section with deformed cross section.

[Fig. 9]

A view showing guide protrusions provided on a surface of a metering plate in the second embodiment.

[Fig. 10]

A view showing guide protrusions provided on an end face of a needle in the third embodiment.

[Fig. 11]

A view for explaining a structure of the injection nozzle to which the present invention is applied.

[Fig. 12]

A top view of the nozzle hole of the prior art, from a position over the plate.

[Fig. 13]

Views showing a flow of fuel in the neighborhood of the nozzle hole of the prior art, wherein

(A) is a view from a position over the nozzle hole.

(B) is a sectional view.

[EXPLANATIONS OF THE REFERENCE NUMERALS]

2...needle

3...metering plate

5...nozzle hole

10...vortex flow generator

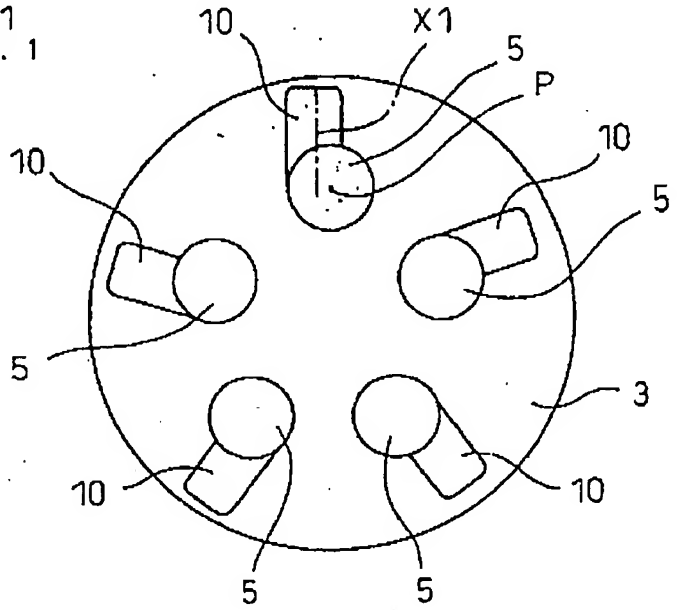
11...guide protrusion (located on a metering plate)

12...guide protrusion (located on an end surface of the needle)

【書類名】 図面
[NAME OF DOCUMENT] DRAWINGS

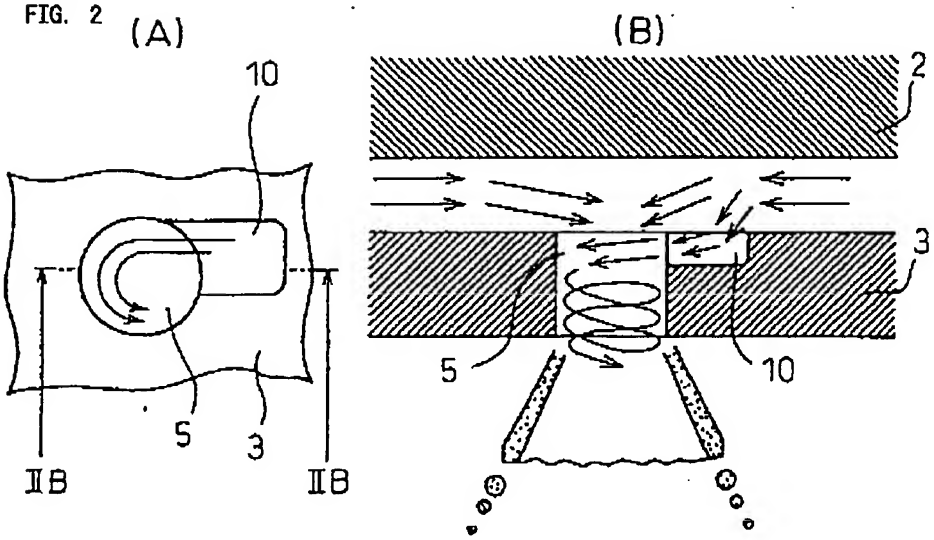
【図１】
[FIG. 1]

図1
FIG. 1



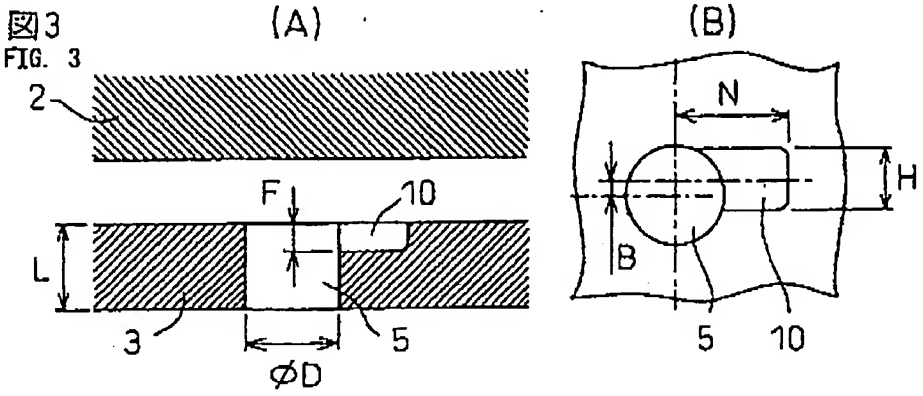
【図２】
[FIG. 2]

図2
FIG. 2



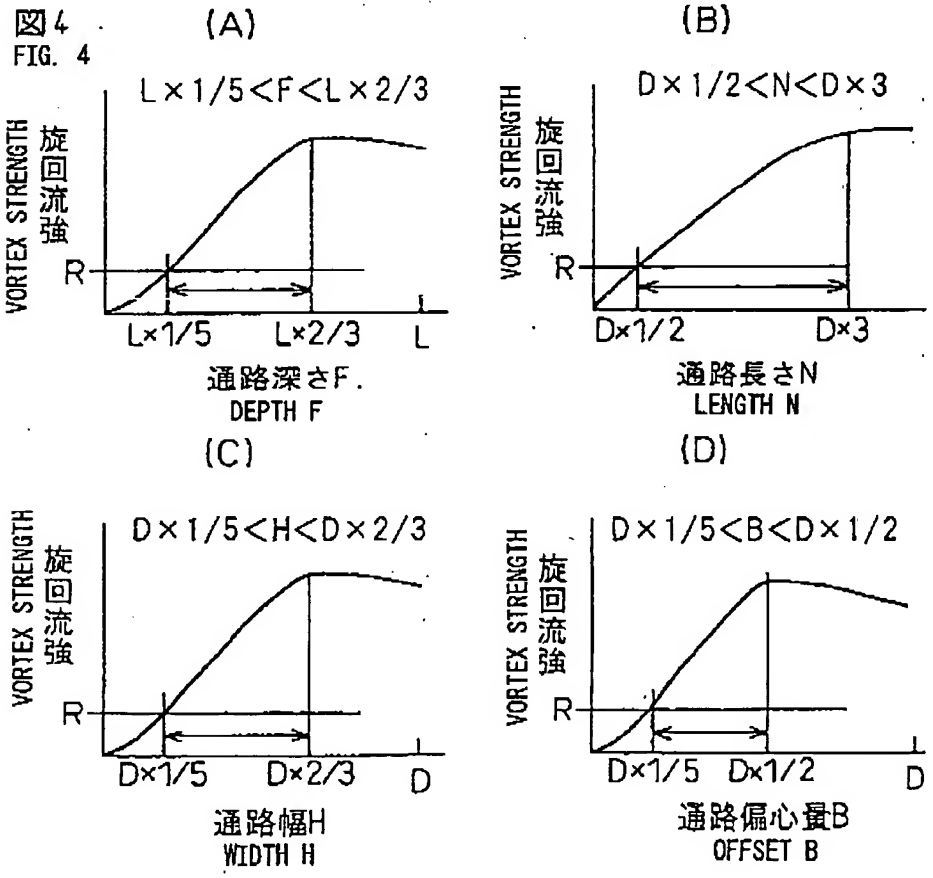
【図３】
[FIG. 3]

図3
FIG. 3



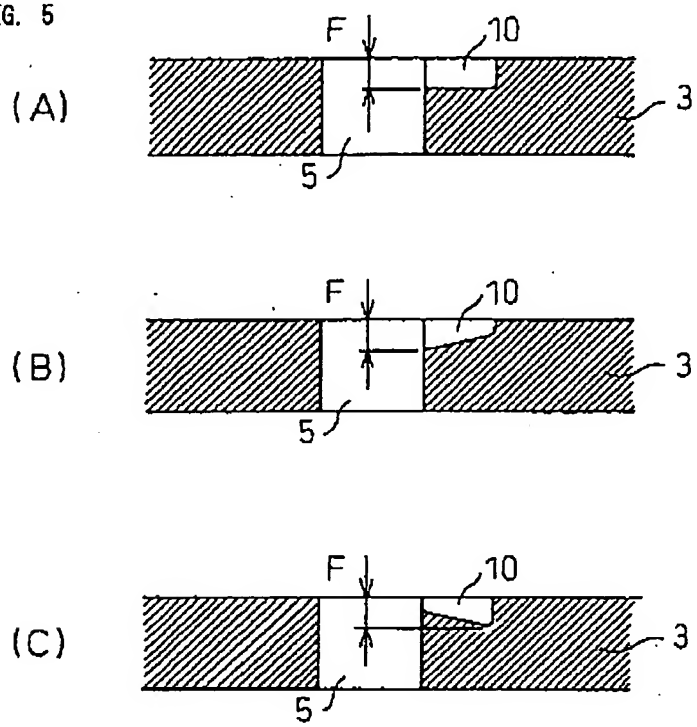
【図４】
[FIG. 4]

図4
FIG. 4



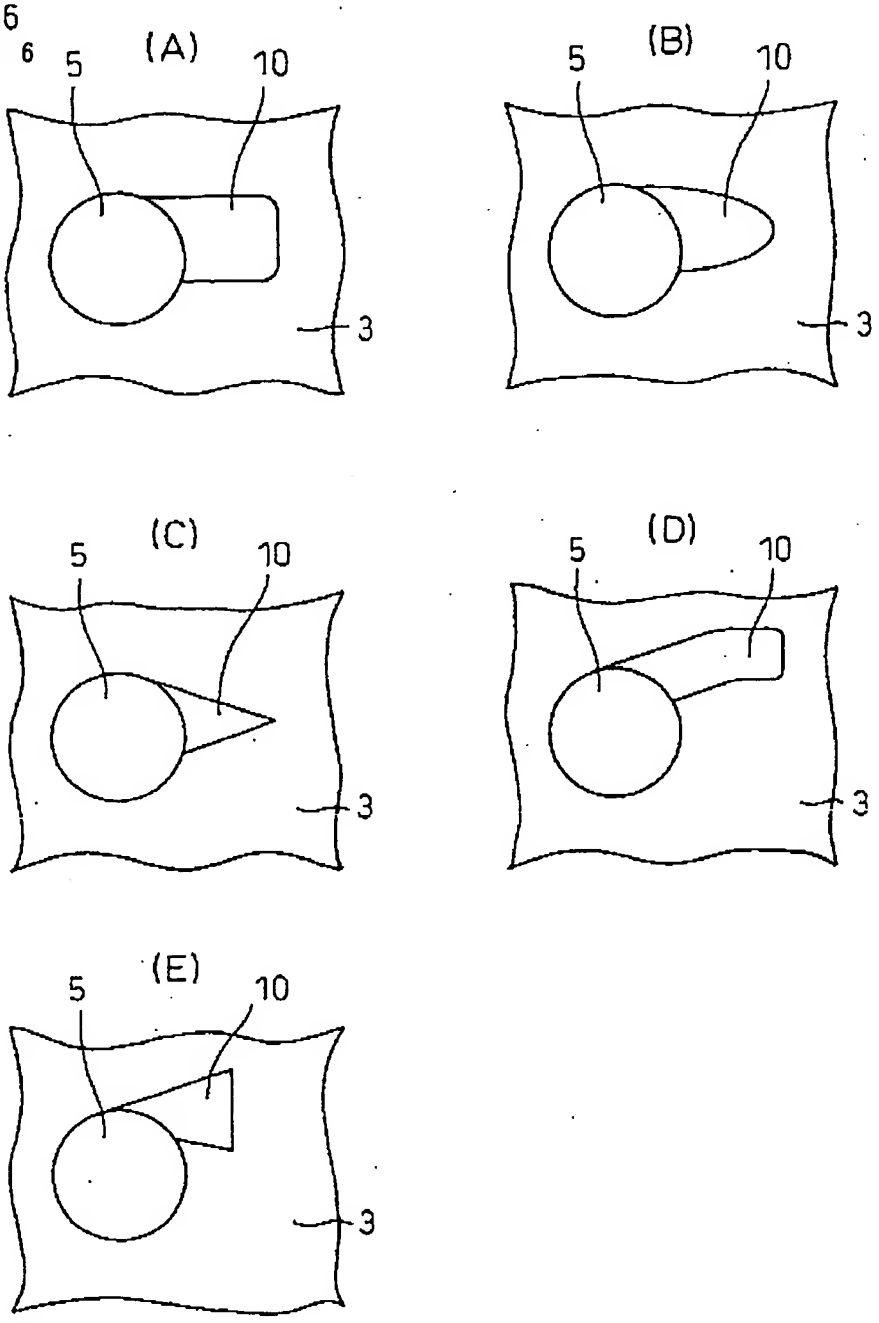
【図５】
[FIG. 5]

図5
FIG. 5



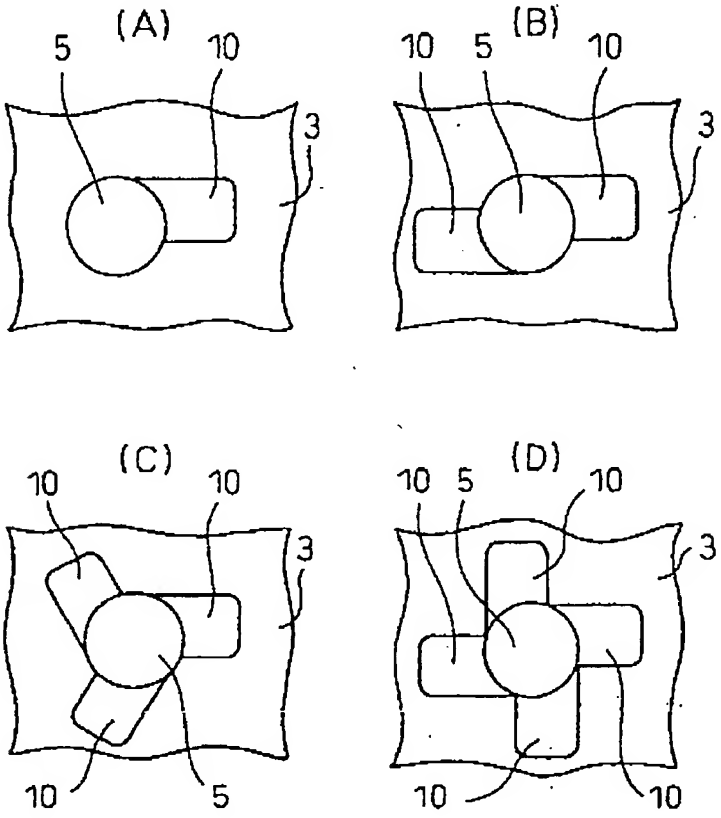
【図６】
[FIG. 6]

図6
FIG. 6



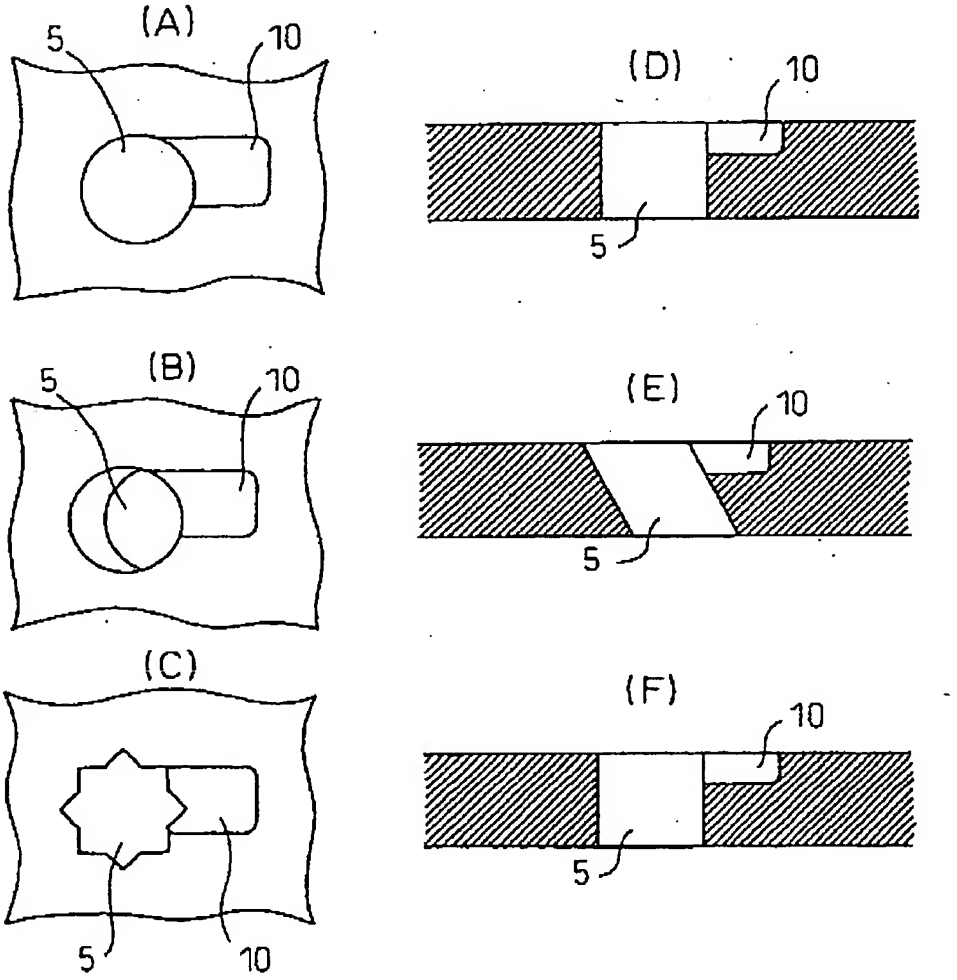
【図７】
[FIG. 7]

図7
FIG. 7



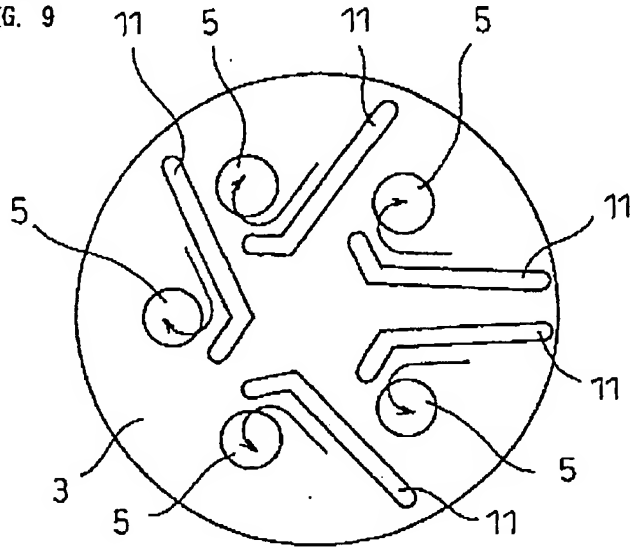
【図８】
[FIG. 8]

図８
FIG. 8



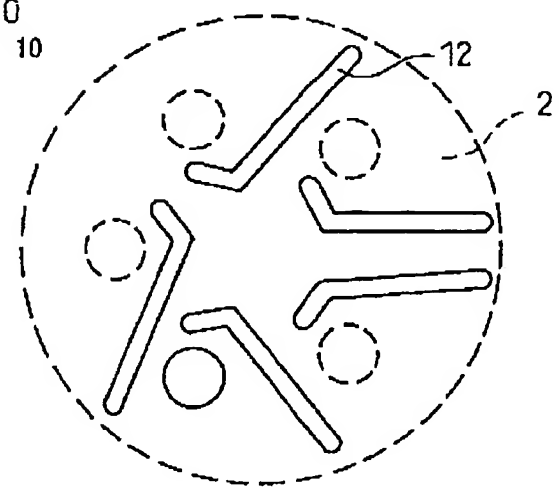
【図９】
[FIG. 9]

図9
FIG. 9



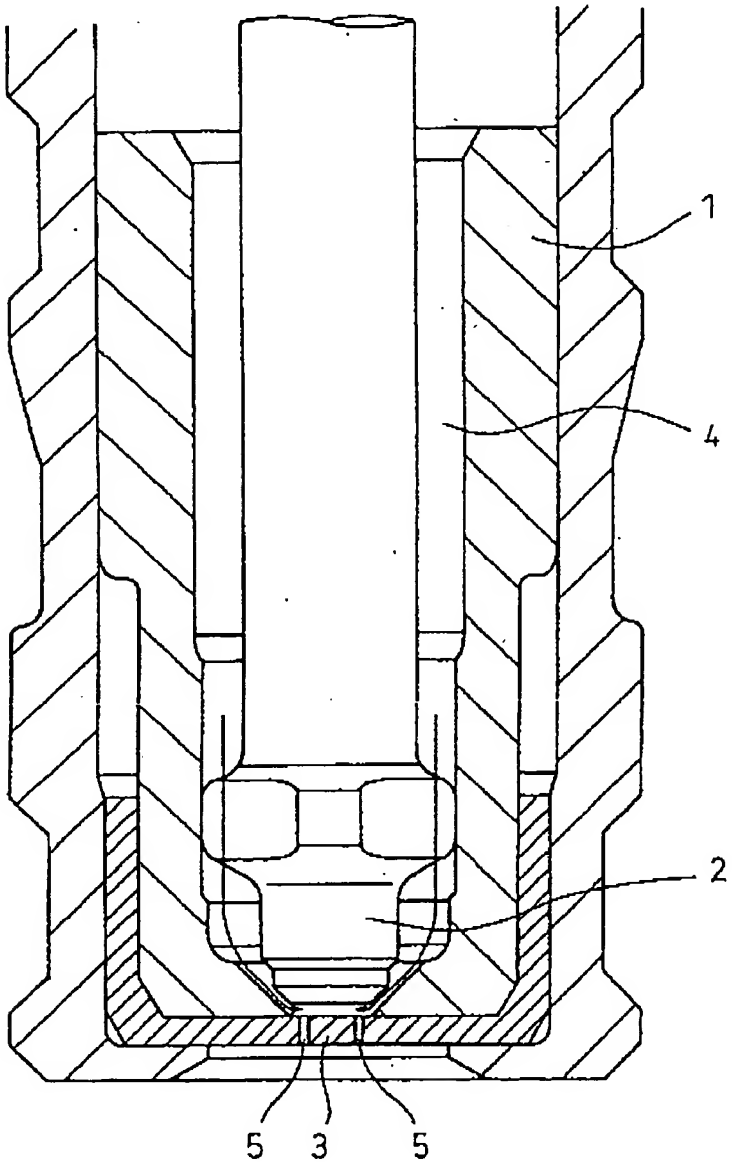
【図１０】
[FIG. 10]

図10
FIG. 10



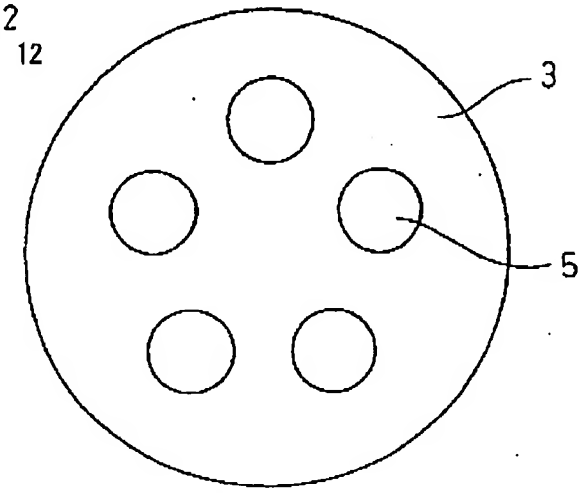
【図１１】
[FIG. 11]

図11
FIG. 11



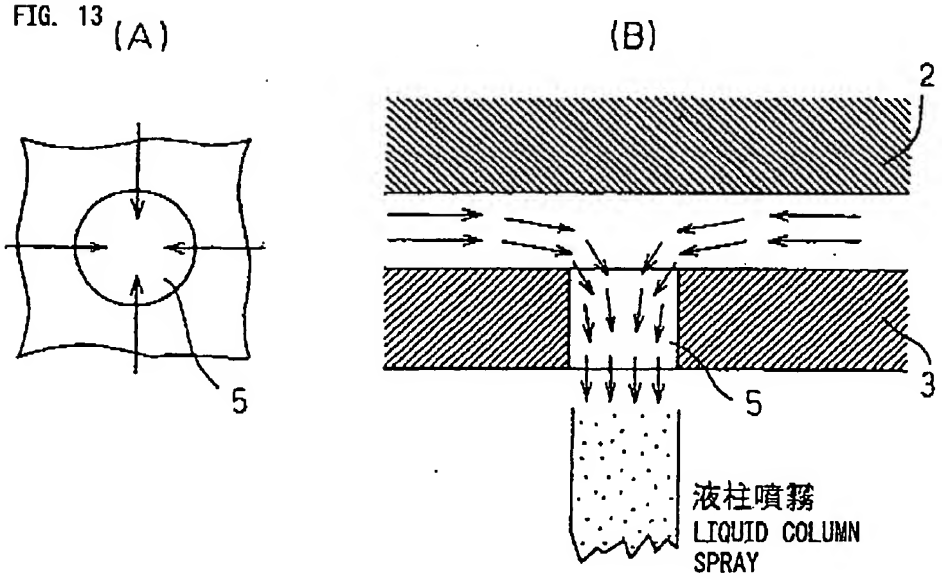
【図１２】
[FIG. 12]

図12
FIG. 12



【図１３】
[FIG. 13]

図13
FIG. 13



[NAME OF DOCUMENT]

Abstract

[ABSTRACT]

[OBJECT]

It is an object of the present invention to provide a fuel injection valve capable of better atomizing a fuel.

[MEANS FOR SOLUTION]

A plurality of nozzle holes (5) is provided on a metering plate (3), and a vortex flow generator groove (10) is provided on an upper face of the metering plate.

A center line X of the vortex flow generator groove in the longitudinal direction is shifted from center of the nozzle hole so that the center line cannot pass through center of the nozzle hole. One wall face of the vortex flow generator groove in the longitudinal direction is tangentially connected to the wall face of the nozzle hole. The vortex flow generator groove is formed so that the following relations are established,

$L \times 1/5 < F < L \times 2/3$

$D \times 1/2 < N < D \times 3$

$D \times 1/5 < H < D \times 2/3$

$D \times 1/5 < B < D \times 1/2$,

where F is depth of the vortex flow generator groove, N is length, H is width, and B is an offset of the center line in the longitudinal direction from the center of the nozzle hole.

[SELECTED DRAWING]

Fig. 1